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PROPENSITY ANALYSIS

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Propensity Analysis

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Enhancing Causal Inference: "Propensity Scores"

- What's the problem?
- So what?
- What's the solution?

Enhancing Causal Inference Using "Propensity Scores"

- Q: Why are we doing this?
- A: To answer questions from the GFA:
  - Are there differences in outcomes for diverted vs nondiverted individuals?
  - What is the relative effectiveness of pre- and post-booking program models?
  - What is the relative impact of specific components of the various diversion models?
  - Etc.

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- In other words, we are trying to make a causal inference about the effectiveness of a variety of approaches to diversion from jail to treatment for people with co-occurring disorders.

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- The "Gold Standard" for establishing cause and effect relationships is the randomized experiment.

- Unfortunately, that's not what we have!

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- Instead, we have *quasi-experiments*, which represent a major subclass of the broader class of *observational studies*

- More specifically, we have *nonequivalent comparison group* designs

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- So what?
  - In experiments, internal validity is high because the groups are identical at baseline *except for chance variation*.
  - In quasi-experiments, the groups are *different* at baseline, *by design* (not by chance) -- this is a threat to internal validity.

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- Therefore:
  - Any differences we observe between groups at follow-up MAY be due to intervention effects
  - OR they may be due to differences in characteristics between the groups
  - OR both!

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- Woe is us, woe is us!
- Whatever shall we do?

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- In graduate school, we learned that we could deal with baseline differences between groups using a magic trick called *analysis of covariance* (ANCOVA).

- ANCOVA allows one to test the difference between groups *while controlling statistically for baseline differences.*

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- In graduate school we also may have learned about *one* of the limitations of ANCOVA:
  - it only controls for variables included in the model, and therefore differences between the groups in characteristics not measured CANNOT be controlled.

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- Additionally, as usual, the devil is in the details:
  - They may not have mentioned that the degree of "control" afforded by ANCOVA models depends on the overlap in characteristics between the two groups.

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- Unfortunately, the less the overlap, the less effective the "control"

- This problem is compounded when the samples are relatively small -- e.g., group sizes of 100 or less [too many empty cells in the matrix]

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- The problem is that ANCOVA analysis software gives you an answer regardless of the actual overlap, so unless you take the trouble to look you may be misled by the results.

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- So, what's the alternative?

- One method that's becoming popular is the "propensity score" approach described by Rubin -- similar in conception to the "Heckman adjustment" used by econometricians

Enhancing Causal Inference Using "Propensity Scores"

- Primary References:
  - Rubin, DB (1997). Estimating effects from large data sets using propensity scores. *Annals of Internal Medicine*, 127 (8), 757 - 763.
  - Heckman, JJ, & Hotz, VJ (1989). Choosing among alternative nonexperimental methods for estimating the impact of social programs. *Journal of the American Statistical Association*, 84 (408), 862 - 880.

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- Basic concept is:
  - (a) to create subgroups of study participants who are similar across a broad range of characteristics, and then
  - (b) test the intervention effect within those groups -- i.e., within homogeneous subgroups, compare the outcomes of those who did vs did not receive the intervention

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- A "propensity score" is a model-based predicted probability of receiving the experimental intervention (in our case, of being in the diversion group)

- Predictors in the model are any/all of the potential confounding variables (i.e., characteristics on which the groups differ)

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- Procedure is:
  - Compute predicted probability for each study participant
  - Divide the total group of participants into about 5 "propensity subgroups," based on their predicted probabilities, with equal numbers of participants (i.e., about one-fifth of the total) in each subgroup

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- Procedure (continued):
  - Examine actual group membership of persons within the propensity subgroups
  - Keep fingers crossed that each subgroup contains adequate numbers of people from intervention and control groups

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- If so, test intervention vs control outcomes within each subgroup, and keep fingers crossed that intervention effects are similar across subgroups

- Combine findings across subgroups to estimate "overall" effect, weighting the subgroups by the inverse of the variances

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- Conducting the analysis this way:
  - effectively controls for *all* of the covariates included in the propensity models
  - facilitates examination of the consistency of the intervention effect across subgroups of participants
  - minimizes the loss of df in controlling for confounders